# HEAT RESISTANCE OF *LISTERIA INNOCUA* IN LIQUID MEDIUM AS AFFECTED BY THE CULTURE GROWTH PHASE

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## OBJECTIVE

Analysis of the effect of culture growth phase on the heat resistance of *Listeria innocua* 10528.

## INTRODUCTION

The presence of *Listeria monocytogenes* and *L. innocua*, in many food products, has been reported in the literature. Despite being non pathogenic, *L. innocua* is physiologically very close to *L. monocytogenes*, becoming an adequate microorganism for this study.

The survival of *L. innocua* has been widely studied, however, most of the research works were carried out using stationary phase cultures.

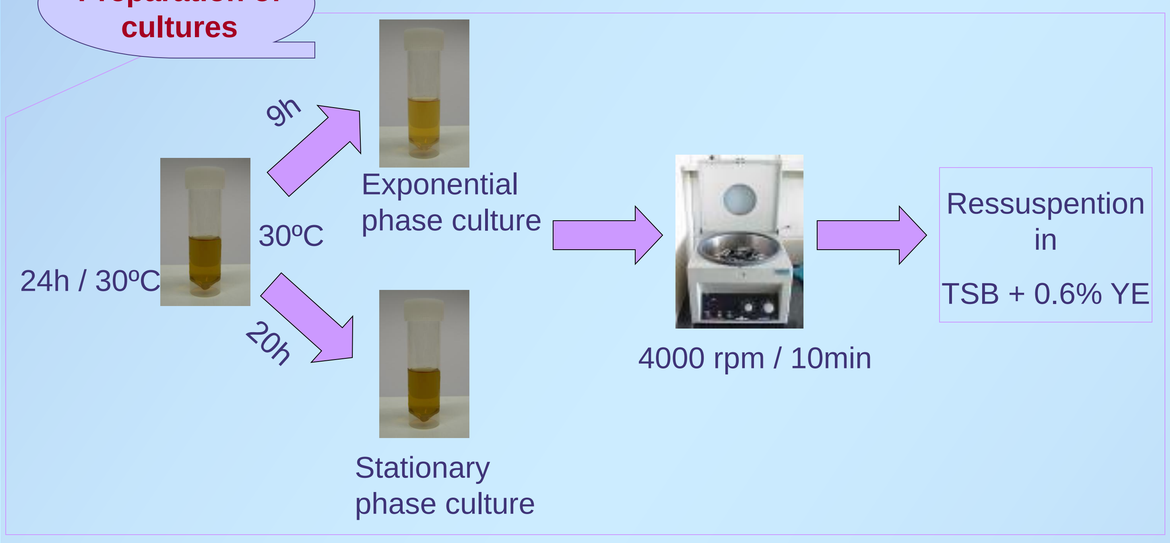
This work intends to compare the thermal inactivation of *L. innocua* using cells in different growth phases (exponential and stationary), and analyse the influence of temperature on its survival.

## MATERIALS & METHODS

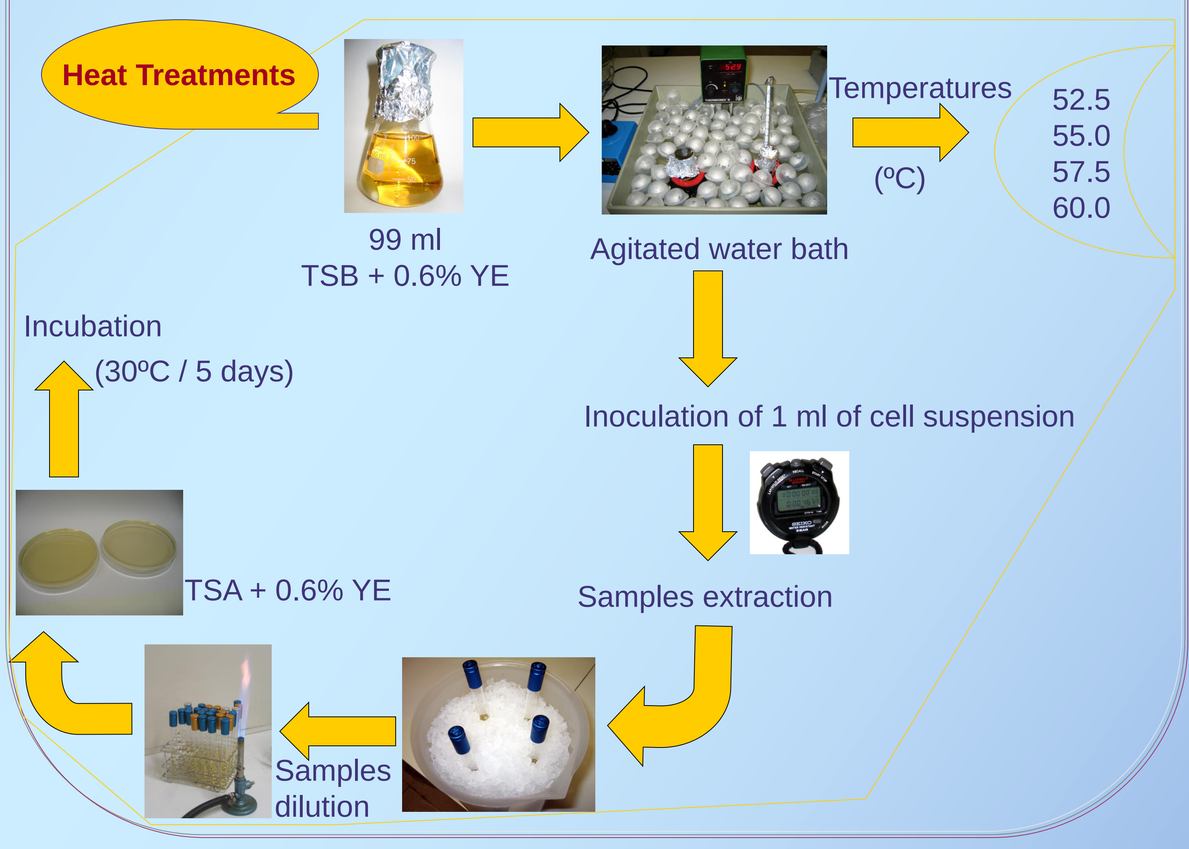
**Culture conditions**

*L. innocua* NCTC 10528 was subcultured (30ºC, 24h) in Tryptic Soy Broth (TSB) containing 0.6% of yeast extract (YE), and maintained at 7ºC on Tryptic Soy Agar (TSA) supplemented with 0.6% of YE.

**Preparation of cultures**




**Heat Treatments**




## RESULTS & DISCUSSION

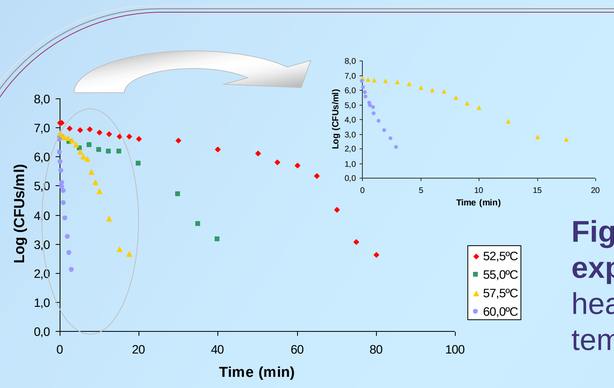



**Fig. 1 -** Survival curves of **exponential culture** of *L. innocua,* heated in broth medium, at different temperatures.

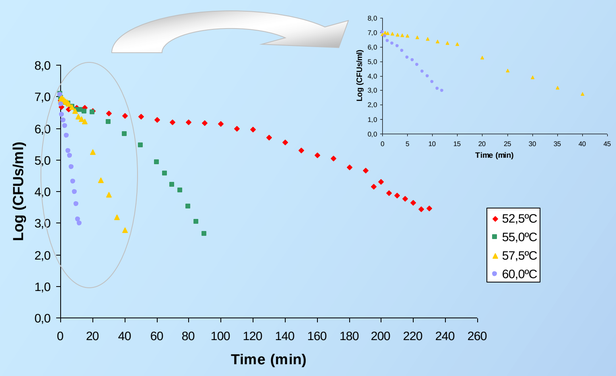



**Fig. 2 -** Survival curves of **stationary culture** of *L. innocua,* heated in broth medium, at different temperatures.

- As the temperature of the heating medium increases, the heat resistance of *L. innocua* decreases.
- Almost all survival curves exhibit shoulder and tailing regions, specially at the lowest temperatures.

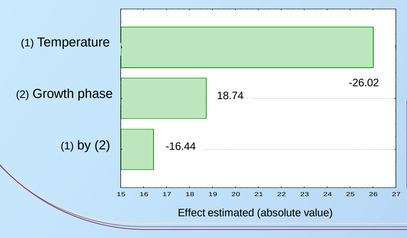
**Table 1 –** Influence of culture growth phase on D- and z-values of *L. innocua* 10528.

| Temperature (ºC) | D-values (min) | |
|---|---|---|
| | Exponential phase | Stationary phase |
| 52,5 | 10,27 | 45,45 |
| 55,0 | 8,07 | 18,32 |
| 57,5 | 3,23 | 7,79 |
| 60,0 | 0,69 | 2,99 |
| z-values (ºC) | 6,39 | 6,38 |

- The heat resistance was evaluated by parameter D (decimal reduction time) ➡ maximum slopes of the survival curves.
- D-values for stationary phase cultures of *L. innocua* are greater than those obtained for exponential phase cultures, as expected.
- The cells growth phase did not affect z-values.

### Analysis of the Effect of Temperature and Culture Growth Phase on D-Value

Results from $2^2$ Factorial Design (Box *et al*., 1978)




Levels of variables

| Temperature (ºC) | Growth phase |
|---|---|
| (+) 60 | (+) Exponential phase |
| (-) 52,5 | (-) Stationary phase |

- Temperature has the major negative effect on D-values (as temperature increases, D decreases).
- Temperature effect is 1.4x higher than the growth phase effect.

## CONCLUSIONS

- Thermal inactivation of *L. innocua* does not follow a first order kinetics, since an initial shoulder and/or a tail behaviour are observed.
- The results show a gradual loss of resistance of *L. innocua* 10528 with the increase of the heating medium temperature.
- Stationary phase cultures are more heat resistant than exponential phase cultures ➡ The cellular growth phase of *L. innocua* has a notorious effect on the microorganism's heat resistance.

## ACKNOWLEDGMENTS

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Box, G. E. P., Hunter, W. G. and Hunter, J. S. (1978). Statistics for experimenters. An introduction to design, data analysis, and model building. John Wiley & Sons, Inc., New York, USA